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⑥ デイフアレンシアルギヤークース等の金属加工法

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⑨ 発 明 者 出願人に同じ

⑩ 出 願 人 荏羽成孝

岡山市上中野54

代 理 人 井理士 滝野文三 外1名

図面の簡単な説明

図は本発明に係るデイフアレンシアルギヤークース等の金属加工法の一実施例を示し、第1図は本発明の加工法によつて作られたデイフアレンシアルギヤークースの平面図、第2図は同上のⅡ-Ⅱ線断面図、第3図は第1図のⅡ-Ⅱ線を断面した場合の上下金型枠、ガイドシリンダー及び第1次製品の縦断側面図、第4図は同上の製造工程途中の縦断側面図、第5図は第1次製品を所定の型に成型したところを示す縦断側面図である。

発明の詳細な説明

本発明は例えばデイフアレンシアルギヤークース等の如く内部が括つているケースを製造する加工法に関するものである。

従来、内部が括つているケースを製造するのに金属板で形成する場合外枠はその形態により所要の型のものに製造工程における如く組合せねばならず、又中枠に於いては組み立てが容易に複雑となりこれを抜き取る際、順序よく解体できる如くしなければならぬため、500噸級のプレスで、ケースとなる鉄板を部分的に打ち抜きこれを所定の型に押し出造して成形し溶着した後、仕上げをする等其に手間がかかる工程を饒ており、出来上った製品の肉厚が鍛造溶着等のため均一とならない欠点があつた。

又近年では何個かの部品を製作し、この部品を一体に組立てることによつて完成品としていたが、これにあつては幾つもの金型を必要とし、それだ

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け製作工程が増え組立て作業が面倒となり、従つてコストが高くなる等の欠陥を有するものであつた。

本発明は叙上の欠陥を是正する為に成されたもので、その目的とするところは、製品の寸法が正確で、且つ全ての肉厚が均一に製作し得るデイフアレンシアルギヤークース等の金属加工法を提供しようとするものであつた。

又本発明の他の目的とするところは、製品の加工途中に於いて成型材料が破断することがないの

で加工時失敗する等の虞れが全くないデイフアレンシアルギヤークース等の金属加工法を提供しようとするものである。

更に本発明の他の目的とするところは、1組の金型装置に於いて製品の成型ができるので組立て工程が大幅に削減し得るデイフアレンシアルギヤークース等の金属加工法を提供しようとするものである。

更に又本発明の他の目的とするところは、製品の成型が容易で量産に適し廉価に供給し得るデイフアレンシアルギヤークース等の金属加工法を提供しようとするものである。

次に本発明に係る金属加工法の一実施例をデイフアレンシアルギヤークースを製作する場合につ

いて説明すれば、AはフランジA₁を有する円筒状の第1次製品、Bは該第1次製品Aを圧延成型する為の金型装置である。尚第1次製品A及び金型装置Bは第1図の製品A'のⅡ-Ⅱ線断面図、即ち製品を直角に切断しその切口側より見た図面である。

1は押上軸2を有する上金型で、その表面1aがデイフアレンシアルギヤークースA'の表面A'₁と同形状に形成されている。

3は該上金型1が上方より密に嵌合されたガイドシリンダーで、その側面に油圧排出孔4が数本設けられている。

5は押下軸6を有する下金型で、その表面5aがデイフアレンシアルギヤークースA'の背面A'₂

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の形状と同じく形成されている。そしてこの下金
型5も前記したガイドシリンダー3の下方より密
に嵌挿されている。尚1b, 5bは油漏れ止用リ
ングである。又下金型5と押上軸6には連通する
油圧送入孔7が穿たれている。

8は油圧ポンプ、9は油流入調節弁で、油圧ポ
ンプ8を作動させ、油流入調節弁9を適宜に調節
して油圧送入孔7へ油を送入する。

10は油排出調節弁で、ガイドシリンダー3よ
り排出された油を油圧排出孔4を介してその流量
を調節しながら排出するものである。

次に加工法について説明すれば、第1次製品A
のフランジA₁を下金型5に嵌合した状態で該下
金型5をガイドシリンダー3内に嵌挿する。(第
4図)

次に油圧ポンプ8から油流入調節弁9で例えば
鉄板を膨出せしめるのに要する圧力が300気圧
の場合最高300気圧に設定された油を当初は油
圧と関係なく下金型5の油圧孔7の任意の個所に
設けた逆流防止弁(図面省略)を経て上下の金型
1, 5の間のガイドシリンダー3内部に位置する
第1次製品Aの内部aから外側の間隙bに送り込
んで空気と共にガイドシリンダー3の油圧排出孔
4より噴出させ、油をシリンダー3内に充填する。
油排出調整弁10は成型材料の破断圧力(成型材
料が内外の圧力差によつて破断する限界即ち圧力
に対する限界)以下例えば破断圧力を110気圧
とした場合成型材の内外の圧力差を110気圧以
下に設定することにより、即ちこの場合第1次製
品Aの膨出に要する気圧が300気圧とした場合、
該第1次製品A内部aの油圧を300気圧とし外
部bは200気圧程度以上に設定することにより
成型材料内外の油圧の関係は破断圧力以下となり、
油圧を300気圧で送り込んだ場合、第1次製品
A内部aの油が下金型5と第1次製品Aの接触部
のフランジA₁の圧接部より漏洩したときでも常
に第1次製品Aの外部bでは300気圧となり調
節弁8, 10の設定圧力と等圧となる。

更に上下金型1, 5のツバ1c, 5cがガイド
シリンダー3に当接するまで上下金型1, 5を油
排出調整弁10の設定圧力(200気圧)に打勝
つて急激に油圧プレスで加圧すると、下金型5と
第1次製品AのフランジA₁との圧接面からの油
の漏洩並びに外部bにある油が油排出調整弁10

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の限界の200気圧に達し200気圧を越えた場
合は該次シリンダー3の油圧排出孔4から噴出す
る状態となり、成型材料内の気圧は油流入調節弁
9の設定圧力の300気圧となつているので成型
材料は破断圧力の限界内で破断することなく油圧
と金型1, 5の加圧の両作用で第1次製品Aは金
型壁に接しながら膨出成形されるものである。尚
膨出部A₂分は瞬間的に油圧と金型1, 5の加圧
で延伸されるため製品の肉厚は均一となるもので

ある。

次に金型1, 5内の油圧を抜きアキュムレー
ター(空素と油を収容するタンクで通常油の流量
圧等の調節に使用するものであるが、この場合は
空素の強力な反撥力により油圧を急激に上げる目
的のために使用する)に蓄圧された油を下金型5
の油圧送入孔7から急激に空素の力で加圧して製
品に衝撃を与えることによつて製品のスプリング
バック(通常油圧と金型の加圧で成型した製品は
成型直後跳ね返りと呼ばれる如き結果が現われる
こと)を除去し精密な製品を得るものである。

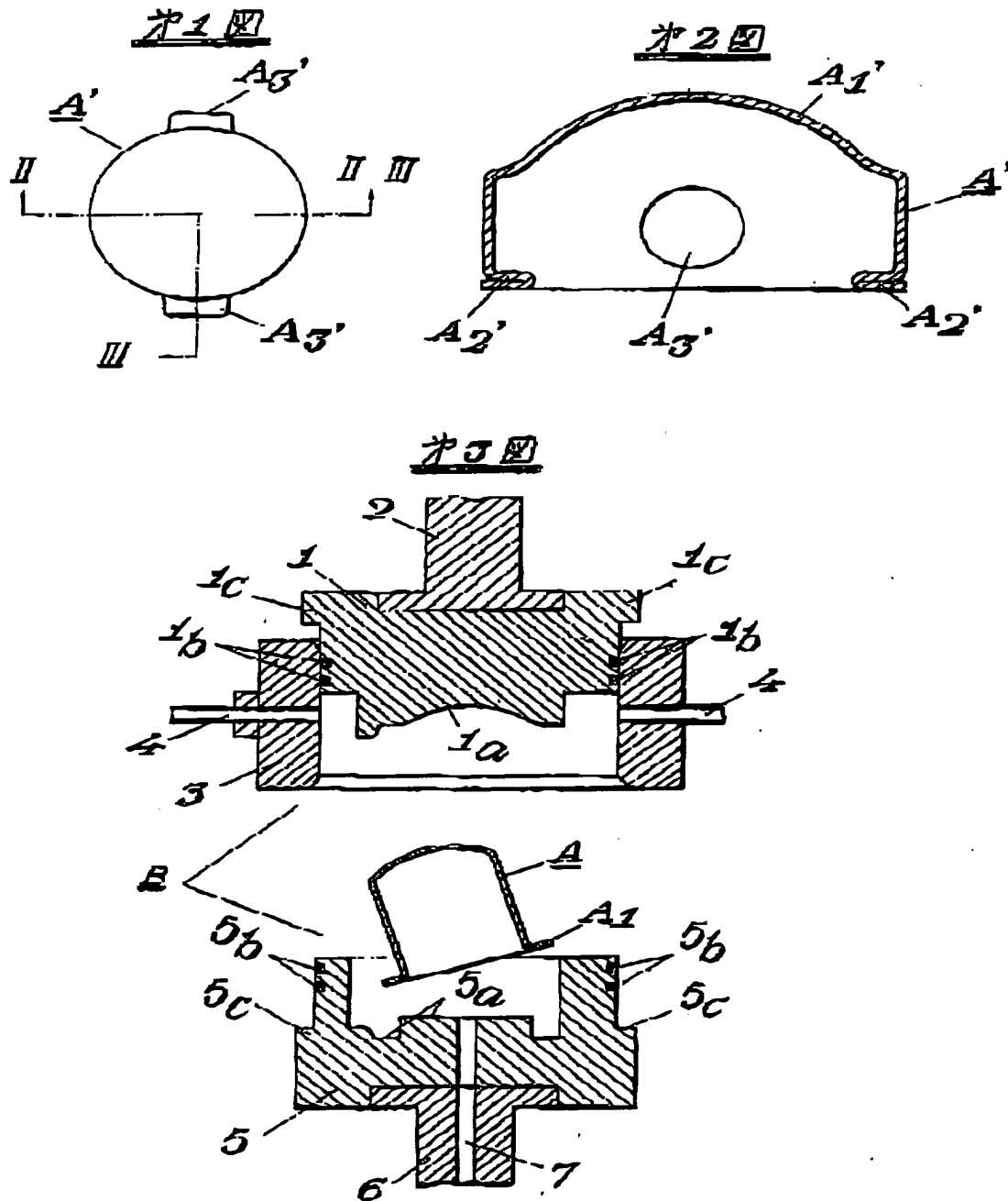
本発明は上記した様にガイドシリンダーの上下
端より嵌挿した上下金型間に成型材料を挿入し、
之を油圧プレスで加圧し製品を有るものであるか
ら組立て等の手間を要することなく容易に製作で
き、又調節弁によつて成型材料内外に於ける油圧
の圧力差を制御する様にしたから、該成型材料に
破断が生ずることがなく従つて製造上の失敗が全
くなく、更に成型後の成型品にアキュムレータ
ーで衝撃を与えスプリングバックを防止したので、
規格通りの製品が得られる外、製造工程が少ない
から量産に適し廉価に供給し得る等の効果を有す
るものである。

特許請求の範囲

1 ガイドシリンダーに嵌挿される上下金型内に
成型材料を挿入し、該成型材料と一方の金型とに
よつて生じる内側空間と、該成型材料と前記した
ガイドシリンダーとによつて生じる外側空間との
間に油を送入すると共にその内側空間との圧力差
を成型材料に破断が生じない様に調節弁で制御し、
且つ金型の加圧と油圧による膨出の両作用で成型
し、然る後内外空間内の油圧を抜いてアキュム
レーターで成型品に衝撃を与えて成るダイフレ
ンシャルキヤークス等の金属加工法。

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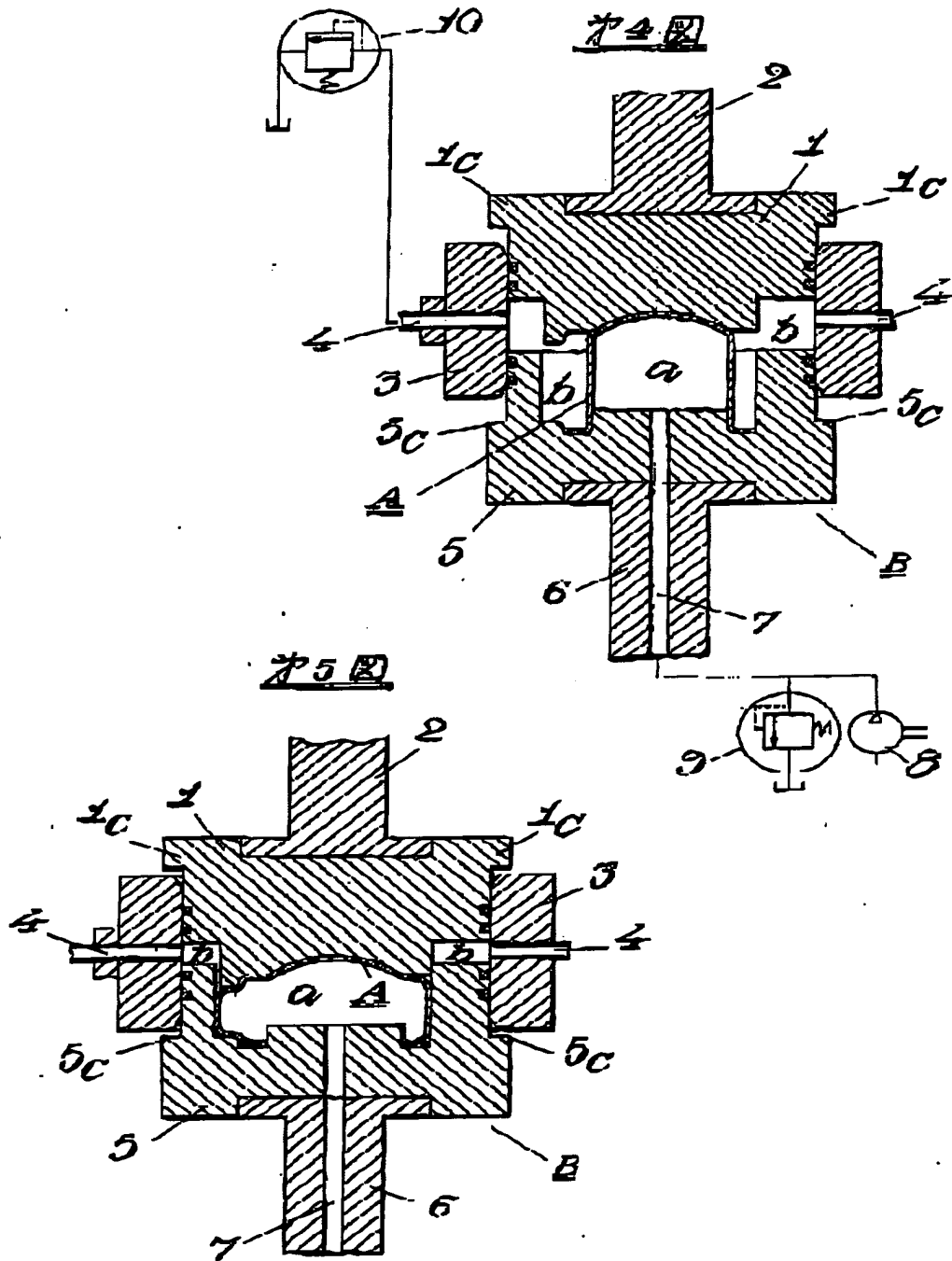
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Inventor: Same as Applicant

Applicant: Nariyoshi Ariha
54 Uenakano, Okayama-shi

Attorney: Patent Attorney Bunzo Takino

Simple Explanation of the Drawings

Fig. 1 shows an embodiment example of the method for metal working of differential gear cases according to this invention. Fig. 1 is a plan-view drawing of a differential gear case manufactured by the metal working method according to this invention. Fig. 2 is a longitudinal-section drawing along line II-II in Fig. 1, Fig. 3 is a longitudinal-section side-view drawing of the upper and lower die frames, guide cylinder, and primary product through line III-III shown in Fig. 1 being cut across, Fig. 4 is a longitudinal-section side-view drawing during the manufacturing process shown above, and Fig. 5 is a longitudinal-section side-view drawing showing primary product forming in a prescribed type of die.

Detailed Explanation of the Invention

This invention relates to a metal working method for manufacture of internally expanding cases, such as eg differential gear cases.

The outer frame conventionally obtained by metal plate forming for manufacture of internally expanding cases necessarily involves, as in manufacturing processes, pre-

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scribed types of dies being combined depending on its shape. The central frame also involves a highly complex assembly process. When the latter are being taken out, this must be done in such a way as to allow effective dismantling. To achieve this, the steel plate envisaged for the case passes through various laborious manufacturing processes, being initially partially punched in a 500 ton class press, formed by die (expansion) forging in a prescribed type of die ensuring good metal deposition, and then finished to shape, a deficiency being that, because of forging material deposition, the completed product lacks a uniform wall thickness.

Recent years have further seen some products being manufactured from a number of partial products, which are integrally assembled to form complete products. This approach, however, implies the need to have various sets of dies available, with the deficiency of assembly and production becoming progressively more complex as the number of manufacturing processes increases in a way that implies heavy costs being incurred.

This invention has been elaborated to overcome the foregoing deficiencies, its purpose being to propose a method for metal working of differential gear cases whereby products with accurate dimensions and completely uniform wall thickness can be obtained.

A further purpose of this invention is also to propose a method for metal working of differential gear cases whereby products can be obtained entirely without the risk of metal working process failure through the forming material being free from fracture during the working process.

A further purpose of this invention is also to propose a method for metal working of differential gear cases whereby the assembly process can be substantially reduced through product forming being able to proceed in a single set of die devices.

A further purpose of this invention is also to propose a method for metal working of differential gear cases whereby product forming is easily accomplished and products can be manufactured at low cost corresponding to volume production.

An embodiment example of the method for metal working of differential gear cases according to this invention is next explained with reference to differential gear case manufacture. A is a circular cylindrical drawn product with flange A₁. B is a die device for compression forming of said primary product A. Primary product A and die device B are shown in a cross-sectional drawing along product A' line III-III in Fig. 1, ie in a drawing representing the product being cut at right angles and viewed from the cut opening side.

1 is an upper die incorporating press-down shaft 2, its surface 1a being formed to the same shape as surface A'₁ of differential gear case A'.

3 is a guide cylinder wherein upper die 1 is snugly fixed from above, its side surface being provided with multiple oil pressure exhaust holes 4.

5 is a lower die incorporating press-up shaft 6, its surface 5a being formed to the same shape as surface A'₂ of differential gear case A'. Lower die 5 is also snugly inserted

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in said guide cylinder 3 from below. 1b, 5b are oil leakage check rings. Communicating oil delivery manifold 7 also penetrates inside lower die 5 and press-up shaft 6.

8 is a hydraulic pump. 9 is an oil inflow regulating valve. Oil is delivered to oil delivery manifold 7 through hydraulic pump 8 being operated and oil inflow regulating valve 9 being regulated as appropriate.

10 is an oil exhaust regulating valve, being arranged to exhaust oil with the flow rate of oil exhausted from guide cylinder 3 being regulated via oil pressure exhaust holes 4.

The metal working method according to this invention is next explained. Said lower die 5 is inserted inside guide cylinder 3 in a state of flange A₁ of primary product A being fixed inside lower die 5 (Fig. 4).

When a pressure of 300 atmospheres is required to expand eg a steel plate, oil set to a pressure of max 300 atmospheres by oil inflow regulating valve 9 from hydraulic pump 8 is delivered into outside gap b from inner zone a of primary product A located inside guide cylinder 3 between upper and lower dies 1, 5 via a non-return valve (not shown) provided at any arbitrary location in oil delivery manifold 7 of lower die 5 in a way initially unrelated to the oil pressure and then sprayed from oil pressure exhaust holes 4 of guide cylinder 3 together with ambient air in order to fill oil inside guide cylinder 3. When the fracture pressure is less than the forming material fracture pressure (the limit of forming material fracture due to the inside and outside pressure difference, ie the pressure limit), such as eg at a fracture pressure of 110 atmospheres, through oil exhaust regulating valve 10 being arranged to set the pressure difference inside and outside the forming material to 110 atmospheres or less, ie, when the pressure required to expand primary product A in this case is 300 atmospheres, the pressure of inner zone a of primary product A is set to 300 atmospheres, and outer zone b is set to a pressure of around 200 atmospheres or more, so that the relationship between the oil pressure inside and outside the forming material is less than the fracture pressure. During delivery at an oil pressure of 300 atmospheres, despite oil in inner zone a of primary product A leaking from the compression zone of flange A₁ in the contact zone between lower die 5 and primary product A, a pressure of 200 atmospheres is normally obtained in outer zone b of primary product A, attaining the same pressure as the pressure set in regulating valves 9, 10.

Until flanges 1c, 5c of upper and lower dies 1, 5 come into contact with guide cylinder 3, provided upper and lower dies 1, 5 are intensely pressurized in a hydraulic press to overcome the set pressure (200 atmospheres) of oil exhaust regulating valve 10, oil leakage from the compression zone between lower die 5 and flange A₁ of primary product A coupled with oil available in outer zone b results in a pressure of 200 atmospheres being attained as the limit of the pressure set by oil exhaust regulating valve 10. Should a pressure of 200 atmospheres be exceeded, oil is arranged to flow out successively from oil pressure exhaust holes 4 of guide cylinder 3. The atmospheric pressure inside the forming material then becomes 300 atmospheres as the pressure set by oil inflow regulating valve 9, so that, through both functions of oil pressure and pressurization of dies 1, 5, entirely without forming material fracture within the fracture pressure limit, primary product A is expanded and formed while in contact with the die wall. Expansion zone A'₃ is also instantaneously extended by oil

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pressure and pressurization of dies 1, 5 to obtain a product with a uniform wall thickness.

When the oil pressure of dies 1, 5 is then removed, the oil pressurized in an accumulator (a device operating to adjust the normal oil flow rate pressures in a tank containing nitrogen and oil, being used in this case to boost the oil pressure significantly as a result of the intense reaction force of nitrogen) is intensely pressurized by the force of nitrogen from oil delivery manifold 7 of lower die 5 to impose a heavy shock on the product. By this means, product spring-back (products formed by oil pressure and die pressurization normally sustain a shrinkage-like effect known as spring-back just after forming) is eliminated to obtain a precision product.

Through a forming material being inserted between upper and lower dies fixed from upper and lower ends of a guide cylinder and through the latter being pressurized in a hydraulic press to obtain a precision product according to this invention as described above, product manufacture can be easily accomplished without any laborious assembly operations being required. Through the pressure difference of the oil pressure inside and outside the forming material being controlled by regulating valves, said forming material sustains no fracture whatever, any manufacturing process failure is accordingly entirely eliminated, and product spring-back is prevented through an intense shock being imposed on the product by an accumulator just after forming in a way that enables good-quality products to be obtained. Through fewer manufacturing processes being required, the invention further confers the effect of products being able to be supplied at low cost corresponding to volume production.

Claims

1. Method for metal working of differential gear cases arranged so that a forming material is inserted between upper and lower dies fixed in a guide cylinder, oil is supplied between an inside space created by said forming material and one die and an outside space created by said forming material and said guide cylinder, the pressure difference with the inside space is controlled by regulating valves so that said forming material sustains no fracture, material forming is accomplished by both functions of die pressurization and expansion due to oil pressure, and an intense shock is then imposed on the formed product by an accumulator as the oil pressure inside the inside and outside spaces is removed.

Fig. 1

Fig. 2

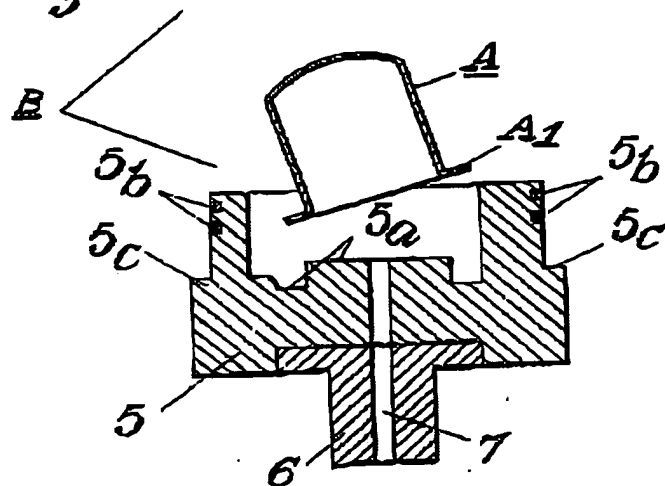
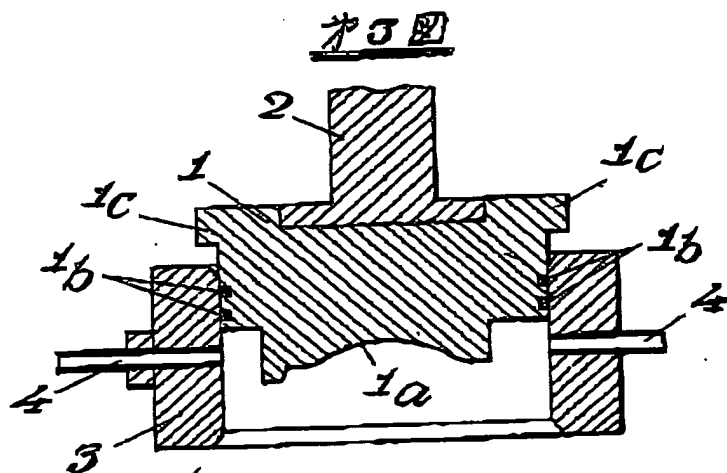
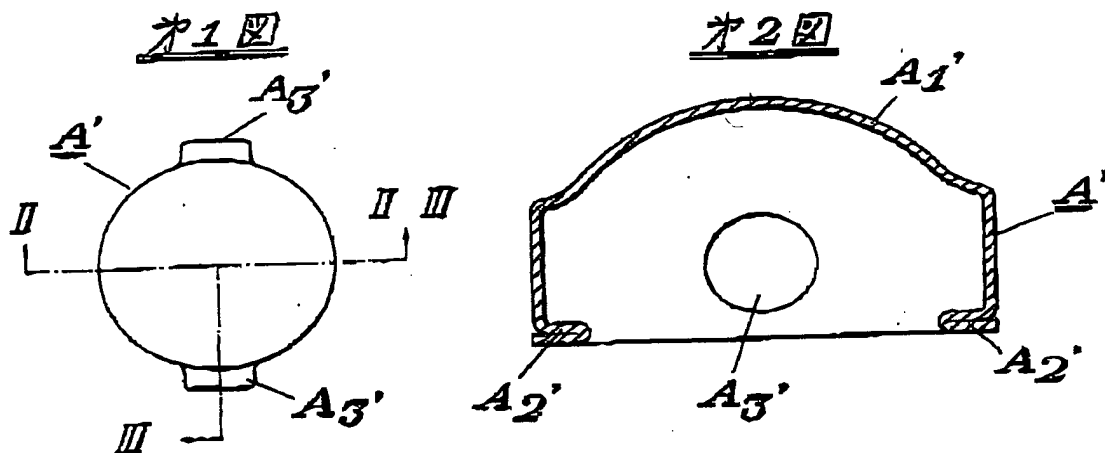
Fig. 3

Fig. 4

Fig. 5

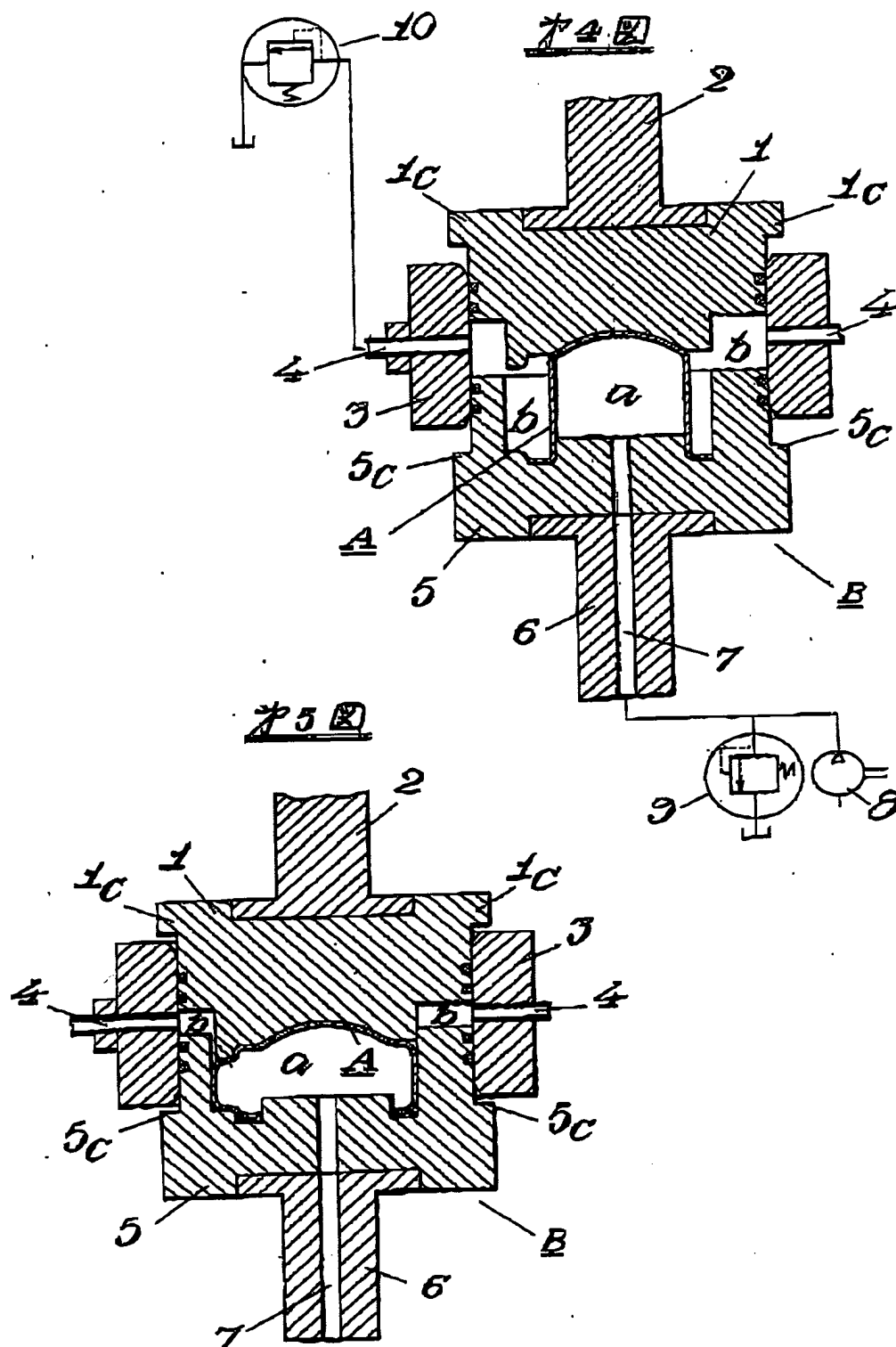
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Summary of JP46-26784

1. Explanation of reference numbers in Figures.

- A' : differential gear case.
- A : primary product
- 3 : guide cylinder
- 1 : upper punch
- 5 : under punch
- 8 : hydraulic pump
- 9 : regulating valve for inputting
- 10 : regulating valve for exhausting

2. The following invention is described.

The oil is filed into inner region (a) and outer region (b) of the primary product in the guide cylinder 3(Fig. 1). The primary product is deformed by the oil pressure and pressing with the upper punch 1 and the under punch 5 while contacting the die wall. The difference between the oil pressure of inner region (a) and the oil pressure of outer region (b) is set less than the rupture stress by the regulating valve 9 and the regulating valve 10.